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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Boyce et al.	Paper No:	
Serial No:	08/056,029	Group:	1502
Filed:	April 30, 1993	Examiner:	Shelborne, K.
For:	A REINFORCED JOINT FOR COMPOSITE STRUCTURES AND METHOD OF JOINING COMPOSITE PARTS	Docket No:	FM-112J

Commissioner of Patents and Trademarks
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Debra M. Berube

APPEAL BRIEF

This Appeal Brief is being submitted in triplicate in accordance with the Notice of Appeal filed on October 22, 1996, in the subject application. The Appeal Brief filing fee in the amount of $150.00 pursuant to 37 CFR §1.17(f) is included herewith.

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Appendix - Copy of claims 1 - 4, 6, 7, 9 - 20, 22, 24 on appeal.

I. REAL PARTY IN INTEREST

The real party in interest in this Appeal is the assignee of the subject application, Foster-Miller, Inc., 350 Second Avenue, Waltham, MA 02154.

II. RELATED APPEALS AND INTERFERENCES

Applicant does not believe that there are any pending appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal of the subject application.

III. STATUS OF CLAIMS

Claims 1 - 22 were filed on April 30, 1993 (S.N.08/056,029). Claims 1 - 4, 6, 7, 9 - 20 and 22 were elected with traverse, and claims 5, 8 and 21 were withdrawn from consideration in Appellant's response of July 13, 1994, to the Examiner's restriction requirement of June 28, 1994.

Claims 1 - 4, 6, 7, 9 - 20, 22 and 24 are pending in this application and are under final rejection. These claims are the subject of this Appeal and are set forth in the Appendix.

IV. STATUS OF AMENDMENTS

An Amendment was filed on December 14, 1994, which involved inserting a Statement of Government Rights into the Specification. This amendment was entered into the record by the Examiner's Advisory Action of December 28, 1994. Claim 24 was

added in response to the Examiner's Office Action of September 11, 1995. This amendment was entered into the record by the Examiner's Office Action of January 17, 1996. Claims 1, 6, 9, 10, 12, 14 - 16, 18, 20, 22 and 24 were amended in response to the Examiner's Final Office Action of April 1, 1996. These amendments were entered into the record by the Examiner's Office Action of July 23, 1996. In the Examiner's Final Office Action of July 23, 1996, claims 1 - 4, 6, 7, 9 - 19, 22 and 24 were rejected. The applicant subsequently filed a Notice of Appeal on October 22, 1996 appealing the objection of claims 1 - 4, 6, 7, 9 - 20, 22 and 24.

V. SUMMARY OF INVENTION

This invention features a method of joining two composite parts. It is very difficult to join two composite parts together, e.g., wherein each composite part includes plies of fabric reinforced by a cured resin matrix.

The prior art includes attempts at using an interlayer material (adherent) used in the joint region between two composite components. An example of this method is disclosed in Holko, U.S. Patent No. 5,021,107. This prior art approach creates a cohesive joint, but failures as shown in applicant's disclosure (6, in Fig. 1) would still occur between the first few plies of the composite material 7 of one part.

In the subject invention, pins are driven through each composite part. The pins are then intersticially arranged at the

joint region between the two parts. An adherent is then disposed about the pins. The pins are locked to each part, the adherent is locked to the pins, and thus the two parts are locked together. The joint which includes the interstitially disposed pins is stronger and more reliable than a joint formed by a mere adherent and the pins ensure that the plies of either part do not delaminate.

VI. ISSUES

A) Whether the Examiner's rejection of the claims under 35 USC §102 (b) is proper as a matter of law;

B) Whether the Examiner's rejection of the claims under 35 USC §103 is proper as a matter of law;

C) Whether the art cited by the Examiner is analogous art.

VII. GROUPING OF CLAIMS

The rejected claims do not stand or fall together and each claim is separately patentable.

VIII. ARGUMENT

Summary of Argument

The applicant claims a method of joining two fiber matrix composite structures (e.g., the composite skin of an aircraft wing attached to a composite stiffener). Composite structures of this type typically include plies or sheets of woven fiber (e.g.,

glass or graphite) bound by a resin matrix.

Prior art methods of joining two or more composite structures or components include the use of epoxies for low temperature joints, the use of silver braze alloys for intermediate temperature joints, and the use of interlayer materials such as $TiSi_2$, vacuum furnaced brazed, for high temperature joints. The problem with all of these joining methods is that failures still occur at the joint or between the first few plies of the composite material, as shown in Fig. 1 of applicant's specification.

The applicant discovered that the strength of a joint between two composite structures could be reinforced by inserting extrinsic reinforcing elements (pins) transverse to the direction of the fibers intrinsic to the composite structures. The extrinsic reinforcing fibers are left extending at the surface of each composite structures at the joint region. A braze or other adherent material is then inserted into the joint region and about the exposed pins. In some cases, the adherent material is urged partially along the length of the reinforcing fibers into each structure to provide a more cohesive bond at the joint region between the composite structures. The combination of the pins and the braze is much stronger than the braze alone since the pins add more surface area at the joint region to which the braze attaches.

The Examiner rejects these claims as being anticipated and

obvious over prior art in which two pieces of material are joined by freeing intrinsic longitudinally extending fibers from each piece of the material for reinforcement in a joint region. None of the references cited by the Examiner disclose or suggest disposing extrinsic fibers in a direction transverse to the direction of the intrinsic fibers of the pieces of material to be joined.

In addition, the Examiner does not limit her reading of the word "composite" in the applicant's claims to the definition of composite disclosed by applicant's specification on page 3 lines 8 - 9, where the applicant states that composite structures "comprise layers of plies each including an array of fibers in a resin matrix".

One difference between the applicant's method of joining the composite parts and prior art method is that the applicant disposes extrinsic reinforcing elements through the thickness of the composite adherends. The word "extrinsic" is defined in the American Heritage Dictionary as meaning originating from the outside; external. An extrinsic thing is not inherently part of the thing.

In contrast, the American Heritage Dictionary defines the word "intrinsic" to mean of or pertaining to the essential nature of a thing; inherent.

The woven longitudinally extending fibers contained in the plies making up the composite structures disclosed by the applicant are examples of intrinsic fibers. The extrinsic

reinforcing elements, however, are disposed through the thickness of the composite adherends including intrinsic fibers. If you were to remove the intrinsic fibers of the plies contained in the resin matrix of a composite part, only the resin would remain. In other words, you would no longer have a composite under the applicant's definition. On the other hand if you remove the extrinsic reinforcing elements claimed by applicant, a composite component would remain.

So, applicant claims a method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherents to be joined, at least a number of the reinforcing elements extending from the joint surface of each said adherend;

assembling the adherends so that the joint surface of one adherend faces the other said adherend defining a joint region therebetween, said extending reinforcing elements interstitially disposed in the joint region; and

disposing an adherent within the joint region about the interstitially disposed reinforcing elements and the joint surfaces. See claim 1. (emphasis added)

The applicant also claims that the adherends are carbon-carbon composite structures, (see claim 2), that the reinforcing elements are fibers, (see claim 3), that the adherent is a metallic braze material (see claim 4) and that the adherent may be a prepreg material. See claims 7, 11 and 17.

ISSUE A: Whether the Examiner's 35 USC §102(b) rejection is proper as a matter of law.

The Examiner argues that the glass fibers running along the length of the long-fiber-reinforced plastic rods disclosed by Born et al., and the cables running lengthwise through the conveyer belting disclosed by the 783035 Publication perform the same function as the extrinsic reinforcing fibers of applicant's claimed invention.

This assertion is incorrect. The glass fibers contained in Born's plastic rods are intrinsic fibers, in other words, the glass fibers are inherent to the essential nature of the long fiber-reinforced plastic rods claimed by Born. If the glass fibers were to be removed, only a pure plastic rod would be left. The material would no longer be a long-fiber-reinforced plastic material as claimed by Born. It would simply be a pure plastic rod.

And, the cables running through the conveyer belting disclosed by the 783035 Publication are also intrinsic to the conveyer belt. If these cables were to be removed all that would be left would be a piece of rubber.

The glass fibers of Born and the cables of the 783035 Publication are somewhat analogous to the intrinsic fibers contained in the plies of fabric making up the composite as defined in applicant's specification. Neither reference, however, teaches extrinsic pins disposed through the thickness of

a part.

The proper test of novelty under 35 U.S.C. 102 makes inquiry whether each element of the claim is embodied in a single prior art reference. National Athletic Supply Corp. v. Muscle-Matic, Inc. et al., 164 U.S.P.Q. 10 (D.C.M.Fla., 1968). The same or identical device or invention must be disclosed in a single prior art structure. Arnel Industries, Inc. v. Aerosol Research Co., 164 U.S.P.Q. 239 (D.C.N.Ill., 1969). There is no anticipation under 35 U.S.C. 102 unless there is a single reference that shows or suggests the structure and relationship of the parts defined in the claims. Hamilton Mfg. Co. v. Westinghouse Electric Corp., 164 U.S.P.Q. 284 (D.C.N.Ill., 1969).

Neither Born nor the 783035 Publication teaches, suggests, or in any way infers disposing extrinsic reinforcing elements through the thickness of composite adherends to be joined, in a direction transverse to the intrinsic fibers of the adherends. Therefore, it is respectfully asserted that applicant's claimed invention is not anticipated by Born and the 783035 Publication. Note that it would probably be impossible to insert extrinsic pins transversely through a long glass rod or a conveyor belt.

Claim 1 is separately patentable since the applicant recites the use of extrinsic reinforcing elements each extending through the thickness of two composite adherends to be joined. In contrast, the 783035 Publication and the Born reference teach only the use of intrinsic reinforcing elements.

Claim 2 is separately patentable since the applicant recites the use of carbon-carbon composite structures, where in contrast, the 783035 Publication teaches only the use of conveyor belting; and the Born reference teaches only the use of long-fiber reinforced plastic rods.

Claim 3 is separately patentable since the applicant recites the use of extrinsic reinforcing elements which are fibers. In contrast, the 783035 Publication discloses only the use of intrinsic reinforcing elements which are conveyor belt ropes, and the Born reference only discloses intrinsic reinforcing elements which are made of glass.

Claim 4 is separately patentable since it recites the use of a metallic braze material as an adherent. The 783035 Publication discloses only the use of rubber as an adherent and the Born reference discloses only the use of resin as an adherent.

Claim 6 is separately patentable since it recites disposing a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherends. In contrast, both the 738035 Publication and the Born reference disclose freeing up intrinsic reinforcing elements by removing some of the surrounding material.

Claims 7 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication discloses only the use of rubber packing, and the Born reference discloses only the use of plastic resin.

Claim 9 is separately patentable since it recites disposing a plurality of extrinsic reinforcing elements each extending through the thickness of a first composite adherend. In contrast, the 783035 Publication and the Born reference only teach using intrinsic reinforcing elements.

Claim 10 is separately patentable since it recites the use of extrinsic reinforcing elements, where in contrast, the 783035 Publication and the Born reference contemplate only the use of intrinsic reinforcing elements.

Claims 11 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication contemplates only the use of rubber packing, and the Born reference contemplates only the use of plastic resin.

Claim 12 is separately patentable since it recites urging an adherend to flow at least partially along the length of extrinsic reinforcing elements within composite adherends. In contrast,

neither the 783035 Publication nor the Born reference disclose urging an adherend to flow along the length of extrinsic reinforcing elements.

Claim 13 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses only joining two ends of a glass fiber reinforced plastic rod.

Claim 14 is separately patentable since it recites selecting a braze material with composite parts and extrinsic reinforcing elements, and applying this braze material to the joint region between composite parts. In contrast, the 783035 Publication discloses using rubber in the joint, and the Born reference discloses only using resin in the joint.

Claim 15 is separately patentable since it recites selecting a braze material with composite parts and extrinsic reinforcing elements, and applying this braze material to the joint region between composite parts. In contrast, the 783035 Publication discloses using rubber in the joint, and the Born reference discloses only using resin in the joint.

Claims 16 is separately patentable since it recites driving extrinsic reinforcing elements into an adherend. In contrast, both the 783035 publication and the Born reference teach freeing up intrinsic reinforcing elements from the surrounding material.

Claim 17 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication contemplates only the use of rubber packing, and the Born reference contemplates only the use of plastic resin.

Claim 18 is separately patentable since it recites driving extrinsic reinforcing elements into an adherend. In contrast, both the 783035 publication and the Born reference teach freeing up intrinsic reinforcing elements from the surrounding material.

Claim 19 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses only joining two ends of a glass fiber reinforced plastic rod.

Claim 20 is separately patentable since it recites the use of a plurality of extrinsic reinforcing elements disposed through the thickness of the composite adherends to be joined. In

contrast, the 783035 Publication and the Born reference disclose freeing up intrinsic reinforcing elements.

Claim 22 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses only joining two ends of a glass fiber reinforced plastic rod.

Claim 24 is separately patentable since it recites inserting extrinsic reinforcing elements transverse to the direction of fibers in the resin matrix of a composite adherend where, in contrast the 783035 Publication teaches only the use of the intrinsic fibers contained in a conveyor belt and the Born reference teaches only using the intrinsic glass fibers contained in a fiber reinforced rod. Neither the 783035 Publication nor the Born reference teach disposing extrinsic reinforcing elements transverse to the direction of fibers in the resin matrix of a composite adherend.

ISSUE B: Whether the Examiner's 35 USC §103 rejection is proper as a matter of law.

The Examiner argues that Born teaches using extrinsic reinforcing elements of sufficient length to extend through the thickness of each plastic rod in a direction transverse to the

direction of fibers inherent in the rods and that Born teaches inserting additional extrinsic reinforcing elements through the thickness of each adherend. The Examiner then goes on to state that the fibers projecting from the face of the rods of Born are the same as the extrinsic reinforcing elements claimed by applicant.

Born discloses using intrinsic reinforcing elements of a long fiber-reinforced plastic rod for the purposes of joining two pieces of such a rod. These fibers run longitudinally through the rod. Born does not teach, suggest, or in any way infer disposing extrinsic fibers transverse to the direction of the longitudinal glass fibers inherent in the rods. These glass fibers are clearly intrinsic to the long fiber-reinforced rod because if they were to be removed, there would be nothing left but plastic.

The American Heritage Dictionary defines the word "transverse" to mean situated or lying across; crosswise. The fiber-reinforced plastic rods disclosed by Born contain no fibers other than the intrinsic longitudinal fibers. Therefore, the Examiner's assertion that Born discloses extrinsic reinforcing elements running transverse to the direction of the intrinsic longitudinal fibers is incorrect.

Furthermore, Born does not solve the same problem that applicant addresses through his claimed invention.

To warrant obviousness objection, the references must teach pursuit of the same problem.

> Thus the question is whether what the inventor did would have been obvious to one of ordinary skill in the art attempting to solve the problem upon which the inventor was working.
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> * * *
>
> The problem solved by the invention is always relevant. The entirety of a claimed invention, including the combination viewed as a whole, the elements thereof, and the properties and purpose of the invention, must be considered.

In re Wright, 6 U.S.P.Q. 2d 1959 (CAFC 1988), pages 1961, 1961, 1962.

The applicant's claimed invention addresses the problem of failures occurring between plies of a composite adherend which has been joined to another composite adherend, as shown in Fig. 1 of applicant's specification. Note that the failures do not occur in the joint region between adherends but rather between the layers of fabric contained in one of the composite adherends.

In contrast, Born addresses the problem of joining the ends of two plastic rods which are reinforced with longitudinally running glass fibers. Born does not address the possibility of failures occurring along the line of the longitudinal glass fibers. Applicant's claimed invention teaches the pursuit of a different problem, and therefore, is not obvious over the Born reference.

The Examiner also rejects claims 1 - 4, 6, 7, 9 - 20, 22 and 24 under 35 USC §103 as being unpatentable over U.S. Patent No. 5,021,107 to Holko in view of Born et al., U.S. Patent No. 5,330,064 to Allum et al. and the 783035 Publication. The Examiner states that the carbon-carbon composite adherends of

Holko are formed by a process that involves disposing a plurality of reinforcing elements throughout the thickness of the composites. (Paper No. 17, Page 5, Lines 5 - 8). The reinforcing elements that the Examiner refers to are the intrinsic fibers contained in the composite. The intrinsic fibers of a composite are not the same as extrinsic reinforcing elements which are disposed through the thickness of a composite which is comprised of layers of plies each including an array of fibers in a resin matrix.

The Examiner goes further to state that Holko does not specifically disclose that reinforcing fibers in the composite extend from the surfaces, and that the secondary art collectively teaches the concept of strengthening a joint between two fibrous adherends by extending the fibers beyond the joint surfaces of the adherends and into the joint area between. (Paper No. 17, Page 5, Lines 9 - 14). The fibers referred to by the Examiner are the intrinsic fibers contained in the composite, not extrinsic reinforcing elements which are disposed through the thickness of, and transverse to, the intrinsic fibers contained in the composite adherends. By disclosing the use of intrinsic fibers to strengthen the joint, the references cited by the Examiner teach away from disposing extrinsic reinforcing elements through the thickness of, and transverse to, the intrinsic fibers contained in the adherends.

None of the prior art cited by the Examiner teaches, suggests or in any way infers that extrinsic reinforcing elements

are disposed transverse to the intrinsic fibers contained in the composite adherends. Accordingly, claim 1 is patentable under 35 USC §103.

ISSUE C: Whether the 783035 Publication and the Born reference are analogous art.

In addition to the fact that the applicant's claimed invention is not obvious as a matter of law under 35 USC §103, it is also clear that the 783035 Publication cited by the Examiner is non-analogous art.

The applicant's invention relates to joining composite laminate structures generally comprising of layers of plies including an array of fibers in a resin matrix.

In complete contrast, the 783035 Publication relates to a method for joining two pieces of a conveyer belt.

One skilled in the art cannot possibly be aware of every teaching in every art and 35 USC §103 states that a "hypothetical person skilled in the art" is to be skilled only in the art to which the subject matter pertains, not to be skilled in every branch of technology, science, and human knowledge.

It is respectfully submitted that those skilled in the art of joining fiber matrix composite structures would not look to the art of manufacturing conveyer belts as shown by the 783035 Publication.

The test for determining whether the 783035 Publication is analogous art is (1) whether the 783035 Publication is within the

field of the inventor's endeavor, and (2) whether the reference is reasonably pertinent to the particular problem to which the inventor was involved. In re Wood, 202 USPQ 171,174 (CCPA 1979).

The 783035 Publication as explained above, is not within the field of the applicant's endeavor of attempting to develop a method of joining fiber matrix composite structures. The problem apparently solved by the 783035 Publication is how to join two ends of a conveyer belt. The 783035 Publication states that the end of the cables in a conveyor belt are separated and divided into their strands, with the butt joint made by forming an overlap between the strands, filling the spaces between them with rubber packing, and vulcanizing the joint. The strands are intrinsic to the conveyor belt and are separated from the surrounding rubber packing.

In contrast, the problem solved by the applicant is the delamination of plies in a joined composite structure. Applicants found that after two composite components were joined the joint would hold but failures would occur between the layers of fibers in the resin matrix of the composite. The specific problem faced by the applicant was the attachment of a stiffener (5, as in Fig. 1) to the inside of the skin of an aircraft wing (7, as in Fig. 1). It is a completely different problem from putting together two ends of a conveyor belt.

In order to perform the method of the 783035 Publication on two composite adherends as defined in applicant's specification, one would have to put the two composite adherends side by side,

free up some of the intrinsic fibers contained in the layers of plies of fabric in the composites by removing some of the resin, and then put the two adherends together and pouring more resin into the joint.

The problem faced by the applicant is not solved by joining two fiber reinforced composites this way. The applicant is attaching a stiffener to the inside skin of an aircraft wing. These stiffeners look like ribs running in a crosswise direction to the length of the wing. The stiffener composite component is placed on top of the composite component which is on the inside skin of the wing. It would not make sense to free up intrinsic fibers of either of these composite components, because doing so would weaken the components. The bonding method disclosed by applicant provides a much stronger bond in this situation. Thus, the bonding method disclosed by 783035 Publication does not reasonably pertain to the particular problems which were faced by the applicant.

Therefore, the 783035 publication is non-analogous art and the applicant's claims 1-4, 6, 7, 9-20, 22 and 24 are allowable since they recite a method of joining composite parts which includes disposing a plurality of extrinsic reinforcing elements extending through the thickness of the adherends into the joint region between them and then disposing an adherent within the joint region.

Similarly, the applicant asserts that the Born reference is not analogous art. The Born reference discloses joining two ends

of a glass fiber reinforced plastic rod. One skilled in the art of joining fiber matrix composite structures would not look to the art of joining long fiber reinforced plastic rods as shown by the Born reference. Thus, applicant asserts that the Born reference is not within the field of the inventor's endeavors. Also, the problem of joining long fiber reinforced plastic rods cannot be considered to be reasonably pertinent to the problem of joining two fiber matrix composite structures, or more specifically joining a stiffener to the inside skin of an aircraft wing. Therefore, the Born reference is also not-analogous art.

Claim 1 is separately patentable since the applicant recites the use of extrinsic reinforcing elements each extending through the thickness of two composite adherends to be joined. In contrast, the 783035 Publication and the Born reference teach only the use of intrinsic reinforcing elements.

Claim 2 is separately patentable since the applicant recites the use of carbon-carbon composite structures, where in contrast, the 783035 Publication teaches only the use of conveyor belting; and the Born reference teaches only the use of long-fiber reinforced plastic rods.

Claim 3 is separately patentable since the applicant recites the use of extrinsic reinforcing elements which are fibers. In

contrast, the 783035 Publication discloses only the use of intrinsic reinforcing elements which are conveyor belt ropes, and the Born reference only discloses intrinsic reinforcing elements which are made of glass.

Claim 4 is separately patentable since it recites the use of a metallic braze material as an adherent. The 783035 Publication discloses only the use of rubber as an adherent and the Born reference discloses only the use of resin as an adherent.

Claim 6 is separately patentable since it recites disposing a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherends. In contrast, both the 738035 Publication and the Born reference disclose freeing up intrinsic reinforcing elements by removing some of the surrounding material.

Claims 7 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication discloses only the use of rubber packing, and the Born reference discloses only the use of plastic resin.

Claim 9 is separately patentable since it recites disposing a plurality of extrinsic reinforcing elements each extending through the thickness of a first composite adherend. In

contrast, the 783035 Publication and the Born reference only teach using intrinsic reinforcing elements.

Claim 10 is separately patentable since it recites the use of extrinsic reinforcing elements, where in contrast, the 783035 Publication and the Born reference contemplate only the use of intrinsic reinforcing elements.

Claims 11 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication contemplates only the use of rubber packing, and the Born reference contemplates only the use of plastic resin.

Claim 12 is separately patentable since it recites urging an adherend to flow at least partially along the length of extrinsic reinforcing elements within composite adherends. In contrast, neither the 783035 Publication nor the Born reference disclose urging an adherend to flow along the length of extrinsic reinforcing elements.

Claim 13 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses

only joining two ends of a glass fiber reinforced plastic rod.

Claim 14 is separately patentable since it recites selecting a braze material with composite parts and extrinsic reinforcing elements, and applying this braze material to the joint region between composite parts. In contrast, the 783035 Publication discloses using rubber in the joint, and the Born reference discloses only using resin in the joint.

Claim 15 is separately patentable since it recites selecting a braze material with composite parts and extrinsic reinforcing elements, and applying this braze material to the joint region between composite parts. In contrast, the 783035 Publication discloses using rubber in the joint, and the Born reference discloses only using resin in the joint.

Claims 16 is separately patentable since it recites driving extrinsic reinforcing elements into an adherend. In contrast, both the 783035 publication and the Born reference teach freeing up intrinsic reinforcing elements from the surrounding material.

Claim 17 is separately patentable since it recites the use of a prepreg material as an adherent in the joint region, where in contrast, the 783035 Publication contemplates only the use of rubber packing, and the Born reference contemplates only the use of plastic resin.

Claim 18 is separately patentable since it recites driving extrinsic reinforcing elements into an adherend. In contrast, both the 783035 publication and the Born reference teach freeing up intrinsic reinforcing elements from the surrounding material.

Claim 19 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses only joining two ends of a glass fiber reinforced plastic rod.

Claim 20 is separately patentable since it recites the use of a plurality of extrinsic reinforcing elements disposed through the thickness of the composite adherends to be joined. In contrast, the 783035 Publication and the Born reference disclose freeing up intrinsic reinforcing elements.

Claim 22 is separately patentable since it recites a method of joining a composite part with a non-composite part, where the composite part contains extrinsic reinforcing elements. In contrast, the 783035 Publication teaches only a method of joining two ends of a conveyor belt, and the Born reference discloses only joining two ends of a glass fiber reinforced plastic rod.

Claim 24 is separately patentable since it recites inserting

extrinsic reinforcing elements transverse to the direction of fibers in the resin matrix of a composite adherend where, in contrast the 783035 Publication teaches only the use of the intrinsic fibers contained in a conveyor belt and the Born reference teaches only using the intrinsic glass fibers contained in a fiber reinforced rod. Neither the 783035 Publication nor the Born reference teach disposing extrinsic reinforcing elements transverse to the direction of fibers in the resin matrix of a composite adherend.

If for any reason this BRIEF is found to be INCOMPLETE, or if at any time it appears that a TELEPHONE CONFERENCE with counsel would help advance prosecution, please telephone the undersigned or his associate, Joseph S. Iandiorio, collect in Waltham, Massachusetts, (617)890-5678.

Respectfully submitted,

Kirk Teska
Reg. No. 36,291

APPENDIX

1. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherends to be joined, at least a number of said reinforcing elements extending from the joint surface of each said adherend;

assembling said adherends so that the joint surface of one said adherend faces the joint surface of the other said adherend defining a joint region therebetween, said extending reinforcing elements interstitially disposed in said joint region; and

disposing an adherent within said joint region about said interstitially disposed reinforcing elements and said joint surfaces.

2. The method of claim 1 in which said adherends are carbon-carbon composite structures.

3. The method of claim 1 in which said reinforcing elements are fibers.

4. The method of claim 1 in which said adherent is a metallic braze material.

6. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements

each extending through the thickness of two composite adherends, said reinforcing elements extending from the joint surface of each said adherend;

assembling said adherends so that the joint surface of one said adherend faces the joint surface of the other adherend;

disposing an adherent interlayer between said opposing joint surfaces;

urging said extending reinforcing elements of each said adherend through said adherent interlayer and interstitially locking said reinforcing elements therein.

7. The method of claim 6 in which said adherent interlayer is a prepreg material, the method further including the step of curing said material.

9. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements each extending through the thickness of a first composite adherend to be joined, at least a number of said reinforcing elements extending from the joint surface of said first adherend;

assembling said first adherend with a second adherend such that the joint surface of the first said adherend faces the joint surface of the second said adherend at the joint region therebetween, said extending elements of said first adherend disposed against the joint surface of said second adherend; and

disposing an adherent within said joint region.

10. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements each extending through the thickness of a first component adherend at the joint surface of said first adherend, at least a number of said reinforcing elements extending from the joint surface of said first adherend;

assembling said first adherend with a second adherend such that the joint surface of the first said adherend faces the joint surface of the second said adherend;

disposing an adherent interlayer between said opposing joint surfaces; and

urging said extending reinforcing elements of said first adherend through said adherent interlayer and against the joint surface of the second said adherend and locking said reinforcing elements therein.

11. The method of claim 10 in which said adherent interlayer is a prepreg material, the method further including the step of curing said prepreg.

12. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherends at the joint surface of each said adherend to be joined;

assembling said adherends so that the joint surfaces of one said adherend faces the joint surface of the opposing said

adherend;

disposing an adherent within the joint region defined by said facing joint surfaces and urging said adherent to flow at least partially along the length of said reinforcing elements within said adherends.

13. A method of joining a composite part with a non-composite part comprising:

inserting, through the thickness of said composite part, a plurality of reinforcing elements extending from the joint surface thereof;

assembling said composite part such that said reinforcing elements are proximate the joint surface of said non-composite part; and

brazing said joint surfaces and said reinforcing elements to form a joint.

14. A method of joining composite parts comprising:

inserting, through the thickness of each said composite part, a plurality of extrinsic reinforcing elements extending from the joint surface thereof;

assembling said composite parts such that said reinforcing elements are interstitially disposed at the joint region therebetween;

selecting a braze material compatible with said composite parts and said reinforcing elements;

applying said braze material to said joint region; and

urging said braze material to flow about said interstitially disposed reinforcing elements; and

allowing said braze material to harden.

15. A method of joining composite parts comprising:

inserting, through the thickness of one said composite part, a plurality of extrinsic reinforcing elements extending from the joint surface thereof;

assembling one said composite part with a second composite part such that said reinforcing elements are disposed about the joint surface of said second composite part;

selecting a braze material compatible with said composite parts, and said reinforcing elements;

applying said braze material to the joint region between said composite parts;

urging said braze material to flow about said reinforcing elements; and allowing said braze material to harden.

16. A method of joining composite parts comprising:

inserting, through the thickness of each said composite part, a plurality of extrinsic reinforcing elements extending from the joint surface thereof;

selecting an adherent interlayer material for joining said parts;

assembling said composite parts such that said joint

surfaces face each other with said adherent interlayer therebetween;

driving said reinforcing elements into said adherent interlayer and curing said interlayer locking said reinforcing elements therein.

17. A method of claim 16 in which said adherent interlayer is a prepreg material and the step of driving said reinforcing elements and curing includes subjecting the assembly to elevated pressure and temperature.

18. A method of joining composite parts comprising:

inserting, through the thickness of one composite part, a plurality of extrinsic reinforcing elements extending from the joint surface thereof;

selecting an adherent interlayer material for joining said parts;

assembling said composite parts such that said joint surfaces face each other with said adherent interlayer therebetween;

driving said reinforcing elements into said adherent interlayer and curing said adherent interlayer locking said reinforcing elements therein.

19. A method of joining a composite part with a non-composite part comprising:

inserting, through the thickness of said composite part, a plurality of reinforcing elements at least at the joint region thereof;

assembling said composite part such that said reinforcing elements are disposed proximate the joint surface of said non-composite part; and

brazing said joint surfaces and urging braze material to flow along the lengths of said reinforcing elements into said composite part.

20. A method of joining composite parts comprising:

disposing a plurality of extrinsic reinforcing elements through the thickness of the composite adherends to be joined, at least a number of said reinforcing elements exposed at the joint surface of each said adherend;

assembling said adherends so that the joint surface of one said adherend faces the joint surface of the other said adherend defining a joint region therebetween; and

disposing an adherent within said joint region and about said exposed reinforcing elements and said joint surface.

22. A method of joining a composite part with a non-composite part, comprising:

inserting, through the thickness of said composite part, a plurality of extrinsic reinforcing elements at least at the joint region thereof, said reinforcing elements exposed at

the joint surface of said composite part;

assembling said composite part such that said exposed reinforcing elements are disposed proximate the joint surface of said non-composite part; and

disposing an adherent about said exposed reinforcing elements and said joint surfaces.

24. A method of joining composite parts comprising:

inserting a plurality of extrinsic reinforcing elements each extending through the thickness of two composite adherends to be joined, each composite adherend containing fibers in a resin matrix, said reinforcing elements inserted transverse to the direction of the fibers in the resin matrix, said reinforcing elements left extending from the joint surfaces of each adherend;

assembling said adherends one on top of the other so that the joint surface of one said adherend faces the joint surface of the other said adherend defining a joint region therebetween, said extending reinforcing elements interstitially disposed in said joint region; and

disposing an adherent within said joint region about interstitially disposed reinforcing elements and said joint surfaces.